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Determination Sunscreen Potential Based on Sunflower Seed Oil (Helianthus Annuus) in Cream Preparation With Combination of Oxybenzone and Octyl Methoxycinnamate by in Vitro Method

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Abstract

Sun exposure can cause erythema and sunburn to cause degeneration of the skin such as premature aging and some skin cancers. Due to the negative effects of the sun's rays, we need to use a sunscreen skin protector. Natural materials for sunscreen preparations is commonly use because it is easy accept by the community. Sunflower seed oil is one of the natural ingredients that contains vitamin E which is as an antioxidant and also has the potential as a sunscreen. This study is purpose to determine the effect of adding sunflower seed oil to the effectiveness of a combination of oxybenzone and octyl methoxycinnamate sunscreen, determine the SPF (Sun Protection Factor) value, and determine the pH value of each cream preparation.The research includes the preparation of sunflower seed oil cream (Helianthus annuus), which consists of an in vitro test for SPF value, and pH test using a spectrophotometer UV-Vis. The results of the average SPF value of F1 (blank) is 8.24; F2 (blank + Oxybenzone 2% + Octyl methoxycinnamate 5%) is 21.26; F3 (1% sunflower seed oil) is 26.03; F4 (5% sunflower seed oil) is 26.84; and F5 (10% sunflower seed oil) is 28.88.

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In conclusion, this study result indicate that the addition of sunflower seed oil in various concentrations gives a significant difference in the increase of SPF values between each formula combined with oxybenzone and octyl methoxycinnamate.

Keywords: Sun Exposure; Sunscreen; Sunflower Seed Oil; Oxybenzone; Octyl Methoxycinnamate; SPF; pH; spectrophotometer UV-Vis.

1. Introduction

Sun exposure has been identified as the risks to increasing rates of skin cancer since the 1970s, and one thing to prevent it is by changing lifestyles. A short effect that is widely known from sun exposure is the occurrence of redness (erythema) or commonly known as sunburn. Due to the negative effects of the sun exposure, we need to use a protective sunscreen. Sunscreen function is to absorb or spread sunlight, so the intensity less be able to reach the skin. Sunscreen are cosmetic preparations that are usually applied to the surface of the skin and it generally contains photo protector active ingredients such as vitamin E [1]. Sunflower seed oil contain 609 mg / kg of tocopherol concentration. Alpha-tocopherol (vitamin E) is very effective against UV-B radical damage. Vitamin E protect skin damage by functioning as an antioxidant and capturing free radical compounds which found in ultraviolet and turning it into heat energy and then preventing chain reactions [2]. So, vitamin E plays an important role in photo protection, preventing skin damage from free radicals in ultraviolet [3].

2. Material and Methods

2.1 Materials

1,3-Butylene Glycol, Distilled Water, 96% Alcohol, Stearic Acid, Disodium Edetate, Triethanolamine, Petrolatum, Sterile Alcohol, Glyceril Monostearate, Sodium Metabisulfite, Nipagin, and Sunflower Seed Oil (Helianthus annuus).

2.2 Instrument

Laboratory glassware, UV-Vis spectrophotometer, analytical balance, pH meter, drip pipette, conductor meter, aluminium foil, parchment paper, tissue, mortar, stamfer, spatula and bath water.

2.3 Sunscreen Cream Manufacture Based on Sunflower Seed Oil

The cream base will be made is a type of oil-in-water emulsion. Materials needed include the aqueous phase and oil phase. The aqueous phase consists of 1,3-butylene glycol, disodium edetate, nipagin, sodium metabisulfite, triethanolamine, distilled water. While the oil phase consists of stearic acid, glyceryl monostearate, cetyl alcohol, oxybenzone, and petrolatum. The material will be weighed first, then the oil phase is melted over a water bath using a vaporizer cup at $\pm 70\text{-}75^0$C (mass I). The aqueous phase is dissolved in heated distilled water (mass II). Mass II was put into a heated mortar then slowly added mass I into it while being crushed at a constant temperature of $\pm 70^0$C until cream mass was obtained and octyl methoxycinnamate was added, then added sunflower seed oil, and crushed until homogeneous

2.4 Quality Evaluation of Preparation

- **Homogeneity Test**

A certain amount of preparation is applied to a piece of glass or other transparent material, must show a homogeneous arrangement and no visible grain [4].

- **Determination SPF value**

Using Mansur equation to determine SPF value, it specifically calculates the absorbance at the UVB wavelength, as we know that the SPF only shows protection against UVB rays, but when the measurements are made up to a wavelength of 400nm as additional information about the sample uptake to that wavelength. Using a UV-Vis spectrophotometer at a wavelength of 290-400nm with 96% alcohol will obtained as a blank sample, absorption values were recorded at 5nm intervals at wavelengths of 290-320nm and 10nm intervals at wavelengths of 320-400 nm. The absorbance value which obtained is multiplied by EE x I for each interval. EE x I values for each interval can be seen below (Table 1). The amount of EE x I obtained with this formula below [5].

$$SPF = CF \times \sum_{290}^{320} \times Abs \times EE \times I$$

Table 1: EE x I value (spectrum of erythemal effect x intensity spectrum from the sun)

Wavelength (nm)	EE x I
290	0,0150
295	0,0817
300	0,2874
305	0,3278
310	0,1864
315	0,0839
320	0,0180
Total	1

- **pH Measurement**

The instrument (pH meter) is calibrate using a neutral standard buffer solution (pH 7.01) and an acidic buffer solution (pH 4.01) until the instrument shows the pH value. Samples were made in a concentration of 1%, weighing 1 gram of the preparation and dissolved in 100 ml of distilled water and then electrodes dipped in the solution. Leaving the device shows pH value to a constant. The number indicated by the pH meter is the result of the pH preparation.

2.5 Statistical Analysis

All result made with the same treatment 6 times for each formula. To find out the significant difference in SPF values between formulas a statistical test was conducted using the ANOVA (Analysis of Variance) method with the SPSS (Statistical Package for the Social Sciences) program with a 95% confidence level followed by the Post Hoc Tuckey test.

3. Result and Discussion

3.1 Homogeneity Test

From the experiments conducted on all sunscreen cream formulas, no visible grains obtained on the glass pieces. From this result it can be concluded that the cream is homogeneous.

3.2 Determination SPF value

SPF value result was done with cream preparation dissolved in a solvent then measured and obtained the absorbance which done by in vitro method using a UV-Vis spectrophotometer. The absorbance of each preparation is then measure into the calculation of the Mansur equation.

Table 2: The Average value of the Sun Protection Factor (SPF) and its category

Formula	SPF Value						Average of the SPF	SPF Category
F1	8,19	8,27	8,18	8,31	8,22	8,27	8,24	Maximal
F2	21,67	21,27	21,22	21,02	21,22	21,14	21,26	Ultra
F3	26,32	25,65	25,92	26,24	26,17	25,87	26,03	Ultra
F4	26,81	27,18	26,80	27,00	26,20	27,03	26,84	Ultra
F5	29,52	28,66	28,76	29,17	28,72	28,43	28,88	Ultra

Description:

F1 : Blank (cream base)

F2 : Cream base + Oksibenzon 2% + Oktil metoksisinamat 5%

F3 : Sunflower seed oil 1% + Oksibenzon 2% + Oktil metoksisinamat 5%

F4 : Sunflower seed oil 5% + Oksibenzon 2% + Oktil metoksisinamat 5%

F5 : Sunflower seed oil 10% + Oksibenzon 2% + Oktil metoksisinamat 5%

The sun protection category according to Wasitaatmadja [1], the sun protection in maximum category if the SPF value between 8-15 and more than 15 will become ultra category. SPF is the ratio between the amounts of UV light required to produce sunburn on sun-protected skin with the amount of UV rays needed to produce sunburn

on sun-protected skin [6]. The addition of sunflower seed oil also increases the SPF value significantly compared to F1 and F2. This is because sunflower seed oil contains vitamin E which is an antioxidant. Vitamin E is very effective against free radical damage caused by UV-B rays. Vitamin E absorbs strongly in the 280-320 nm of UV-B [3].The photo protective nature of vitamin E has also been shown to inhibit melanogenesis in the skin [7].

3.3 pH Measurement

Cream stability can be seen from the pH value obtained by the preparation during storage. The results of the average pH measurements of cream preparations can be seen in Table 3.

Table 3: The pH Result

Formula	pH			
	I	II	III	Average
F1	6,9	7	7	6,97
F2	6,9	6,9	6,9	6,90
F3	7	6,9	6,8	6,90
F4	7	7	6,9	6,97
F5	6,9	7	6,8	6,90

The result of determining the pH value can be seen that the results show a pH range that is in accordance with the physiological pH of the "acidic coat" of the skin, which is 4.5-7.0 so there is no risk of causing a negative reaction to the skin.

3.4 Statistical Analysis

After conducting statistical analysis on the SPF value of preparations using One Way Anova, a significance value of 0,000 was obtained so that it can be concluded that the result has a significant difference with a probability less than 0.05 between each formula with different concentrations which added by sunflower seed oil. Using the Tukey method based on the Post-Hoc test results, there is a significant difference in the SPF value between each formula with the addition of sunflower seed oil in different concentrations.

From the table 5 above, can be seen that F5 with 10% concentration of sunflower seed oil gives the highest average SPF value when compared to other formula (28.88). In this case, the greater the concentration of sunflower seed oil added, the greatest SPF value obtained. This shows that sunflower seed oil with combination of oxybenzone and octyl methoxycinnamate can increase the SPF value of sunscreen preparations.

Table 4: Post Hoc Test, Average SPF Value and SPF Category

Cream Formula		Sig.	Average of the SPF	SPF Category
F1	F2	.000	8,24	Maximal
	F3	.000		
	F4	.000		
	F5	.000		
F2	F1	.000	21,26	Ultra
	F3	.000		
	F4	.000		
	F5	.000		
F3	F1	.000	26,03	Ultra
	F2	.000		
	F4	.000		
	F5	.000		
F4	F1	.000	26,84	Ultra
	F2	.000		
	F3	.000		
	F5	.000		
F5	F1	.000	28,88	Ultra
	F2	.000		
	F3	.000		
	F4	.000		

4. Conclusion

The average SPF value of F1 (blank sample) was 8.24; F2 (blank + Oxybenzone 2% + Octyl methoxycinamic 5%) has an average SPF value of 21.26; F3 (1% sunflower seed oil) has an average SPF value of 26.03; F4 (5% sunflower seed oil) has an average SPF value of 26.84; and F5 (10% sunflower seed oil) has an average SPF value of 28.88. The addition of sunflower seed oil in various concentrations gives a significant difference in the increase of SPF values between each formula combined with oxybenzone and octyl methoxycinnamate, this has been shown by the result of this research.

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